

**Sheet Blank for an Exhaust Gas Housing Part of a Motor Vehicle**  
**and Process for the Production of the Exhaust Gas Housing Part with the Sheet Blank**

Cross References to Related Applications -

Not applicable.

Statement Regarding Federally Sponsored Research or Development -

Not applicable.

Background of the Invention

**[0001]** The invention relates to a sheet blank for an exhaust gas housing part of a motor vehicle, in particular for an exhaust gas muffler or an exhaust gas catalyst of an automobile, constituting an upper half shell or a lower half shell of a half shell muffler or half shell catalyst produced by a stamping process in a tool, or a wrapped exhaust gas funnel or exhaust gas cylinder produced by an unrolling process in a tool, or an exhaust gas pipe joint. Furthermore, the invention relates to a process for the production of the exhaust gas housing part with the sheet blank.

Technical Field

**[0002]** The housing of exhaust gas mufflers or exhaust gas catalysts for motor vehicles in half-shell, wrapped, or jacket construction, and also exhaust gas housing parts such as connecting pipes, pipe joints, or connecting funnels, are according to the state of the art constituted with increased requirements on strength, shape stability, and quality, from sheet blanks which are either single-walled, with large wall thickness, or double-walled, from two sheet blanks. If necessary, additional stiffening ribs or creases in the housing part ensure additional stability. The production of both double-walled housing parts or

also single-walled housing parts with sheet blanks of comparatively large wall thickness is expensive. Also, much material is required for a sufficiently stable structure of an exhaust gas housing or exhaust gas housing part. High material costs, increased weight of the exhaust gas system, and also higher gasoline consumption of the motor vehicle are disadvantageous.

#### Summary of the Invention

**[0003]** The invention has as its object to provide a sheet blank for the production of an exhaust gas housing part of a motor vehicle, of the kind mentioned at the beginning, and also a production process for a sheet blank or of an exhaust gas housing part, which has high strength and high shape stability, and nevertheless is lightweight.

- a. This object is attained by a sheet blank having at least two assembled blanks that are securely connected together and which, in combination or alone, locally reinforce the finished exhaust gas housing part at least in a wall region of the exhaust gas housing part.

**[0004]** A production process according to the invention for a sheet blank or an exhaust gas housing part is as follows: for a prefabrication of a partially reinforced sheet blank, at least two prefabricated blanks with the same or different wall thicknesses are, in a wall region of a local reinforcement of the exhaust gas housing part to be manufactured, laid positioned flat against one another, or arranged positioned overlapping, or at least two prefabricated blanks of different wall thickness are laid positively abutting one another at the edges at least partially, with the blank with greater wall thickness constituting the wall region of the local reinforcement of the exhaust gas housing part to be manufactured, and

that the blanks in the edge region are then securely connected together by laser welding, by tack welding, or by spot welding.

[0005] The invention discloses a particular construction of a multi-part sheet blank in a prefabrication for an exhaust gas muffler, exhaust gas catalyst, exhaust gas funnel, exhaust gas cylinder jacket, exhaust gas pipe joint, or the like, to be manufactured in half-shell, wrapped, or jacket construction.

[0006] In particular, a sheet blank for an exhaust gas part for a motor vehicle, particularly for an automobile exhaust gas muffler or exhaust gas catalyst which is produced by a stamping process in a tool, or a wrapped exhaust gas funnel or exhaust gas cylinder produced by an unrolling process in a tool, or an exhaust gas pipe joint, by means of at least two assembled blanks, which are firmly secured together and which, in combination or alone, locally reinforce the finished exhaust gas housing part (half shell, funnel, cylinder or pipe joint) at least in one wall region.

[0007] In a basic first embodiment variant, there are provided a first blank corresponding to the total extension of the exhaust gas housing part to be manufactured and at least a second, smaller blank which constitutes the wall region of the local reinforcement of the exhaust gas housing part to be manufactured.

[0008] The second blank can be a wall strip with a rectangular or square shape, which forms the wall section of the local reinforcement of an exhaust gas cylinder to be manufactured or of a half shell to be manufactured.

[0009] Preferably, the second blank can also be an axially symmetrical wall strip which is widened or narrowed in the middle, has two opposed convex or concave edges, and

constitutes the wall region of the local reinforcement of a half shell to be manufactured of an exhaust gas muffler or of an exhaust gas catalyst.

[0010] The second blank can advantageously also be a trapezoidal wall region of an equal-sided trapezoid, which constitutes the wall region of the local reinforcement of an exhaust gas funnel to be manufactured.

[0011] The first and second blanks preferably have an equal wall thickness and consequently can be cut from the same basic material.

[0012] The first and second blanks can however have different wall thicknesses.

[0013] The blanks preferably lie flat, close to one other, and are securely connected together at least partially at the edge.

[0014] In a second variation of the basic embodiment, a sheet blank provides for a first and a second blank, preferably of equal wall thickness, which overlap at the edges in the wall region of the local reinforcement, and are securely connected together at least partially at the edge.

[0015] The wall region of the local reinforcement or of the overlapping region of the two blanks can, in plan view, have a strip shape with opposed convex or concave edges and widened or narrowed middle, trapezoidal shape or rectangular or square shape, corresponding to the exhaust gas housing part (half shell, funnel, cylinder or pipe joint) to be manufactured.

[0016] In a third variation of the basic embodiment, the sheet blank is characterized by at least two blanks of different wall thickness, which are jointed together positively at one edge, and are securely connected together in the joint region, the blank with the greater

wall thickness forming the wall region of the local reinforcement of the exhaust gas housing part to be manufactured.

[0017] Three blanks, positively mutually abutting and securely connected together at the edges, of a sheet blank are advantageous, namely two lateral blanks with a smaller wall thickness and, arranged between them, a middle blank with a greater wall thickness which constitutes the wall region with the local reinforcement of the exhaust gas housing part to be manufactured.

[0018] The two lateral blanks with the smaller wall thickness are preferably constituted alike.

[0019] The wall region of the local reinforcement of the two blanks of the third basic embodiment variant can in plan view likewise have a strip shape with opposed convex or concave edges and widened or narrowed middle, trapezoidal shape or rectangular or square shape, corresponding to the exhaust gas housing part (half shell, funnel, cylinder or pipe joint) to be manufactured.

[0020] The individual blanks of the multi-part sheet blank are securely connected together in a particular manner, namely preferably partially in the edge region of adjacent blanks by means of laser welding with the particular advantage of a technically and optically flawless, narrow laser weld seam.

[0021] As further connection techniques, tack welding by means of brazing material or additional material, or spot welding or electrical resistance welding, are preferred.

[0022] A process for the production of an exhaust gas housing part provides in particular for a prefabrication of a special sheet blank.

[0023] For a prefabrication of a partially reinforced sheet blank, at least two blanks with the

same or different wall thickness are, in a wall region of a local reinforcement of the exhaust gas housing part to be manufactured, laid positioned flat against one another, or arranged positioned overlapping, or at least two prefabricated blanks of different wall thickness are laid positively abutting one another at the edges at least partially, with the blank with the greater wall thickness or the overlapping region of two blanks constituting the wall reinforcement region of the exhaust gas housing part to be manufactured.

[0024] The blanks in the edge region are then secured together by laser welding, by tack welding, or by spot welding.

[0025] Subsequently the sheet blanks, assembled and welded from at least two blanks, are stamped in a stamping tool which consists of at least a stamp and a die, in order to form, in particular, one (upper or lower) half shell. It will be understood that the stamp and/or die of the stamping tool is correspondingly configured and/or recessed for the partially thicker sheet blank.

[0026] Exhaust gas housing parts, in particular stamped half shells of exhaust gas mufflers and exhaust gas catalysts, can advantageously be formed by means of the invention in a lightweight construction method, without having to accept losses of strength or of shape stability. The exhaust gas housing parts are to be partially reinforced in wall thickness, only at those places at which special requirements for strength are set, by double arrangement of single metal sheets or overlapping of individual metal sheets or by arrangement of an individual metal sheet which is thicker there. The wall thickness of the sheet blank or of the individual metal sheets is small at all other places, so that with the wall reduction there, a weight reduction and saving of material result overall. According

to the state of the art, with single-wall construction of an exhaust gas housing part, a greater thickness, not required per se, of an individual metal sheet or of a sheet blank had also to be provided there, or it was necessary to go over to a double-wall construction.

[0027] The invention is particularly suitable for shell-shaped parts for exhaust gas mufflers and exhaust gas catalysts, but also in other parts in which a weight reduction is possible by different wall thicknesses while safeguarding the requirements regarding body noise, heat shielding, and durability. Thus half-shell parts of an exhaust gas system are preferably reinforced partially at selected places for maintaining function, strength, and heat shielding. The sheet blanks are assembled, and preferably laser welded, from additional metal sheets cut to the final shape, before a stamping or wrapping operation. The high-quality weld seam withstands the stamping or bending processing of the sheet blanks into the final shape. The functioning of the finished exhaust gas housing part is also improved.

#### Brief Description of the Drawings

[0028] The invention is now described in detail using embodiments and with reference to the accompanying drawings.

[0029] Fig. 1 shows in a first embodiment a two-part sheet blank for the production of a single-wall half shell of an exhaust gas muffler, in a schematic cross section.

[0030] Fig. 2 shows the sheet blank according to Fig. 1 in a schematic plan view,

[0031] Fig. 3 shows the sheet blank according to Fig. 1 in its final form of a stamped half shell,

[0032] Fig. 4 shows an exhaust gas muffler manufactured with sheet blanks according to

Figs. 1 and 2, in a perspective view,

[0033] Figs. 5 and 6 show further blanks of sheet blanks in a plan view similar to Fig. 2,

[0034] Fig. 7 shows, in a second variation of the basic embodiment, another sheet blank in a schematic cross section similar to Fig. 1,

[0035] Fig. 8 shows the sheet blank according to Fig. 7, in a plan view similar to Fig. 2 of the first embodiment variant,

[0036] Fig. 9 shows, in a third variation of the basic embodiment, a further sheet blank in a schematic perspective view,

[0037] Fig. 10 shows a half shell housing of an exhaust gas muffler, made with sheet blanks according to Fig. 9, in a schematic cross section,

[0038] Fig. 11 shows the exhaust gas muffler according to Fig. 10 in a schematic perspective view,

[0039] Figs. 12 and 13 show further blanks of sheet blanks in a schematic plan view

[0040] Fig. 14 shows a stamping tool for the manufacture of half shell housings from sheet blanks according to Figs. 1-13, and

[0041] Figs. 15, 16 and 17 show final forms of stamped blanks or of finished half shells, in a schematic cross section.

#### Detailed Description of the Invention

[0042] Shown in the drawing are exhaust gas housing parts of exhaust gas mufflers 2 for an exhaust gas system of a motor vehicle, and also the sheet blanks 1 required for the manufacture, in various embodiment variants, together with a production tool.

[0043] The exhaust gas muffler 2 in half shell construction mode has upper and lower half

shells 6, which are securely connected together in their horizontal parting plane by means of a peripheral fold or an edge weld 20.

[0044] The sheet blank 1 for the exhaust gas housing part of the motor vehicle, particularly for the exhaust gas muffler 2 or an exhaust gas catalyst of an automobile, constitutes after a stamping process in a tool 3, 4, 5 an upper half shell or a lower half shell of a half shell muffler or catalyst, or after an unrolling process in a tool, a wrapped exhaust gas funnel or cylinder, or an exhaust gas pipe joint, and has a particular construction.

[0045] In particular, the sheet blank 1 includes at least two assembled blanks 10, 11, 12, 13, 14, 15, which are securely connected together and which reinforce the finished exhaust gas housing part (half shell, funnel, cylinder or pipe joint), at least locally in a wall region.

[0046] According to a first variation of the basic embodiment, the sheet blank 1 according to Figs. 1-6 includes a first blank 10 corresponding to the developed total extension of the finished exhaust gas housing part, namely a half shell 6, and a second, smaller blank 11, which constitutes the wall region of the local reinforcement of the exhaust gas housing part to be manufactured.

[0047] The second blank 11 is, according to Fig. 2, a wall strip which is widened (or alternatively, narrowed) in the middle with two opposed convex curved edges 7 which constitute the wall region of the local reinforcement of a half shell to be manufactured of an exhaust gas muffler 2 or of an exhaust gas catalyst.

[0048] The first and second blanks 10, 11 have equal wall thicknesses.

[0049] The two blanks 10, 11 lie flat, close to one another, according to Fig. 1, with the

second blank 11 extending over the whole length of the half shell 6 to be manufactured and placed in the middle in the transverse direction relative to the first blank 10, so that according to Fig. 2 a single-walled remaining section of the first blank 10 remains respectively left and right and, in the stamped final form of the sheet blank, forms the two arched sidewalls of the half shell 6 in the region of the peripheral fold or of the edge weld 20.

[0050] The two blanks 10, 11 are connected securely together at the curved edges 7 by tack welding 17 with the use of a melting auxiliary or brazing material or an additional material.

[0051] Both the first and also the second blanks 10, 11 are correspondingly shaped to one another according to size, shape and thickness and relative arrangement of the blanks 10, 11 to one another, corresponding to the requirements of the half shell 6 to be manufactured. Also plural blanks 11 can be arranged lying one over the other or "as islands" on or under the blank 10.

[0052] The said special construction of a sheet blank 1 is not only suitable for the manufacture of half shells 6 of exhaust gas mufflers in half-shell construction mode, but also for the manufacture of other exhaust gas housing parts such as, for example, exhaust gas funnels, exhaust gas pipe joints, exhaust gas cylinders, or jacket sections for exhaust gas catalysts, etc., in wrapped construction mode.

[0053] The second blank 11 can also, according to Fig. 6, be a wall strip with a rectangular or square shape, which can constitute not only the wall region of the local reinforcement of a half shell 6 to be manufactured, but also the wall reinforcement region of a cylindrical

jacket section to be manufactured for an exhaust gas catalyst in wrapped construction mode. The second blank 11 is connected securely to the first blank 10 by means of spot welding 18.

[0054] The second blank 11 can also, according to Fig. 5, furthermore be a trapezoidal wall region of an equal-sided trapezoid which can constitute the wall region of the local reinforcement of, for example, an exhaust gas funnel or exhaust gas pipe joint to be manufactured. The second blank 11 is securely connected to the first blank 10 by means of laser welding 16.

[0055] According to a second basic variation of the embodiment, the sheet blank 1 according to Figs. 7 and 8 includes a first and a second blank 12, 13 of equal (or different) wall thickness, which overlap toward the edge in the wall region of the local reinforcement and are at least partially securely connected together toward the edge.

[0056] The edges of the two blanks 12, 13 are welded together in the overlap region. As welding processes, laser welding 16 and/or spot welding 18 or resistance welding are possible. If necessary, one of the two weld seams can be replaced by tack welding 17.

[0057] The wall region of the local reinforcement or of the overlap region of the two blanks 12, 13 can have, in plan view, a strip shape with opposed convex or concave edges 7 or 8 and widened or narrowed middle, trapezoidal shape, or rectangular or square shape, corresponding to the exhaust gas housing part (half shell, funnel, cylinder or pipe joint) to be manufactured.

[0058] According to a third basic variation of the embodiment, the sheet blank 1 according to Figs. 9-13 includes at least two blanks 14, 15 of different wall thickness, which positively

abut against one other at one edge and are connected securely together in the abutment region S, with the blank 15 with the greater wall thickness S1 constituting the wall region of the local reinforcement of the exhaust gas housing part to be manufactured.

[0059] In the particular embodiment of the drawing, three blanks 14, 15 are provided, abutting one another positively and securely connected together at the edge, namely two lateral blanks 14 with a smaller wall thickness S2 and an interposed middle blank 15, with the greater wall thickness S1, forming the wall region with the local reinforcement of the exhaust gas housing part to be manufactured. The two lateral blanks 14 with the smaller wall thickness S2 are of like constitution.

[0060] Also in the third variation of the embodiment of the sheet blank, the wall region of the local reinforcement of the two blanks 14, 15 can have a strip shape in plan view, with opposed convex or concave edges 7 or 8 and widened or narrowed middle, trapezoidal or rectangular or square shape, corresponding to the exhaust gas housing part (half shell, funnel, cylinder or pipe joint) to be manufactured.

[0061] A process for the production of an exhaust gas housing part in half shell construction mode by means of the said sheet blank 1 now provides that for a prefabrication of a partially reinforced sheet blank 1, at least two prefabricated blanks 10, 11; 12, 13 with the same or different wall thickness are, in a wall region of a local reinforcement of the exhaust gas housing part to be manufactured, laid positioned flat against one another, or arranged positioned overlapping, or at least two prefabricated blanks 14, 15 of different wall thickness are laid positively abutting one another at the edges at least partially, with the blank 15 with the greater wall thickness constituting the wall region of the local

reinforcement of the exhaust gas housing part to be manufactured, and that the blanks 10, 11; 12, 13; 14, 15 in the edge region are then securely connected together by laser welding 16, by tack welding 17, or by spot welding 18.

[0062] A sheet blank 1 prefabricated in this manner is stamped in a tool according to Fig. 14 into the final form of a half shell 6 according to Figs. 3, 4 and 10, 11.

[0063] The tool includes a die 3, a supporting ring 4 and a stamp 5.

[0064] The prefabricated sheet blank 1 is positioned beforehand on the supporting ring 4.

The die 3 then closes in the direction toward the supporting ring, in order to clamp the prefabricated flat sheet blank 1. Thereupon the stamp is moved upward in the direction of the arrow P according to Fig. 14, and carries out the stamping process of the half shell 6 from the semifinished product of the prefabricated sheet blank 1; for stamping, the die 3 together with the supporting ring 4 can also be moved downward against the then stationary stamp 5.

[0065] After the conclusion of the stamping process, the sheet blank receives the shape in the die 3 illustrated in Fig. 14. The weld seams of the two blanks of the sheet blank remain undamaged in the stamping process.

[0066] For example, in the stamping process there arise from the sheet blank 1 the shapes of a half shell 6 shown in Figs. 15, 16 and 17, namely:

[0067] According to Fig. 15, a half shell 6 from a sheet blank 1 according to the third variation of the embodiment;

[0068] According to Fig. 16, a half shell 6 from a sheet blank 1 according to the second variation of the embodiment; and

[0069] According to Fig. 17, a half shell 6 from a sheet blank 1 according to the third variation of the embodiment.

[0070] The said sheet blanks 1 can be subjected, not only to a stamping process, but also, as a prefabricated semifinished product, to a wrapping process in order to produce wrapped exhaust gas housing parts in wrapped or jacket constructional mode with partial jacket reinforcement. The wrapped shells, pipes or jackets are preferably themselves provided with a longitudinal weld seam in the manner of the welding of the individual blanks, namely with laser welding, tack welding or spot welding.